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Book Review

Interplanetary Dust

[Astronomy and Astrophysics Library]
Edited by E Gruen, B A S Gyustafson, S F Dermott and H Fechtig
Springer-Verlag : Berlin-Heidelberg-New York-London-Paris-Tokyo-Hong Kong (2001)
xxv + 804 pages, 242 figures, 46 tables , price : US $ 99.00 (Hardcover),
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More than twenty years ago, Tony McDonnel reviewed the subject of Cosmic dust very comprehensively. After that beautiful work, no good review book on dusts has been published.

Not until the recently published book 'Interplanetary Dust' came out. This volume, a part of Astronomy and Astrophysics Library that is being published by Springer, is entirely devoted to discuss this topic and does so very comprehensively. The Editors of this 800 page volume, namely, E Gruen, B Gustafson, S Dermott and H Fechtig made a tremendous efforts to cover every aspect of the interplanetary dusts such as astronomical observations in Solar system and beyond, measurements of dusts, comets and results of laboratory simulations. When we think of the Solar System, we generally think of the Sun, the planets, moons, planetary rings and probably few asteroids and comets. Very rarely do we give proper importance to one of the most ubiquitous components, namely, the dusts. The present review concentrates on the properties of these dusts and highlights their importance in determining pre-solar and proto-solar environments, formation of grains in cooler regions, *etc*. Of course, whereever possible, links with extra-solar planetary systems are made where processes relating planet and comet formation are observed to be taking place.

The First Chapter deals with the historical perspectives, the origin of the zodiacal light, observation of polarization in this light, scattering of lights and the cause and nature of the rise and fall of the earth's dust belt. Efforts to determine the size of the dust through laboratory experiments and comparison with lunar samples are included. Some of the results of the dust experiments conducted aboard GIOTTO, and VeGa to Comet Halley are also presented. The Second Chapter deals with the optical and thermal properties of the interplanetary dust. Even if the optical depth is low, the scattering of light is important in the visible domain and thermal radiations in the IR domain are also important. This Chapter deals with the Zodiacal and F-corona scattered light and also their thermal emission, brightness, polarization *etc*. The composition of the cloud and its time dependence are also discussed. In the Third Chapter, cometary dust is studied, especially highlighting the dynamical (ejection and motion of dusts, structure and properties of the head and the tail of a comet *etc*) and optical properties (thermal emission characteristics, silicate grains and their emission properties, emissivities, spectral features, albedo *etc*) and how they bring knowledge of physical properties, such as, grain composition *etc* and chemical properties such as isotopic composition, bulk composition and mineralogical composition. In Chapter Four, the near-earth environment is studied. Earth's atmosphere does change the physical properties of the dust by changing the flux, size distribution *etc*. Discussions on results of the analysis of the impact experiments are made.

Cometary tails contain rich information about the dust characteristics. Leonid meteor storm/shower is almost annual event and today it has been possible to exactly pinpoint the age of the debris left over by the comet Temple-Tuttle during its previous passages through which the earth passes and because of which the meteor shower/storm forms. In Chapter Five, analysis of the results of the storm of November, 1999 has been presented with great detail and the models by which future storms could be predicted are briefly discussed. In Chapter Six, analysis of the interplanetary dust samples recovered from polar ice, stratosphere and from deep sea sediments are made and their origin, chemical composition, size distribution, density distribution *etc* are discussed. Detailed metallic abundances are presented in different groups of collected samples. In Chapter Seven, discussions on *in situ* measurements of the cometary dusts are made. Results of HEOS-2, Hiten, Helios, Pioneer-8 and Pioneer-9, Galileo, Ulysses *etc* discussed. The physical properties of interplanetary dusts derived from such satellite missions are discussed in detail.

The next Chapter reviews the existing models on Interplanetary dusts including the early models by Cour-Palais,

Kessler, Gruen *et al*, Zook and then goes on discussing the basics of more modern models. Some comparisons between model predictions and observations are made and new results are presented. In Chapter Nine, a bit of instrumentation used in the flights /satellites are discussed. This is generally readable, and pure theoreticians will also find them useful.

Next two Chapters deal with interactions of dusts among themselves and with radiation. Collision, fragmentation, growth, sublimation, sputtering, charging, scattering with photons, Mie theory, *etc* are discussed in considerable details. In Chapter Twelve, various physical factors which affect the orbits of dusts, such as the dragging by Poynting-Robertson forces, radiation forces, are discussed. Results of numerical simulations are presented. The dust band around the midplane due to asteroid families, and the circum-solar ring of dust particles locked with the earth, warping of the cloud are discussed. In Chapter Thirteen, comparison of physical properties is made of all the circum-planetary dust disks in our solar system. Rings and disks of Jupiter, Saturn, Uranus and Neptune are presented with a great detail giving naturally more attention to Saturn's rings on which abundant data is available. Particle trajectories inside the rings are also studied in presence of moons and other perturbations In Chapter Fourteen, more general discussions are made referring to interstellar dusts and circum-stellar dust disks. Being ubiquitous and always evolving, dusts play a major role in shaping the internal dynamics of the galaxies. In this Chapter, properties of the dusts such as emission spectra, scattering, absorption features, fluorescence and luminescence, molecular abundances, *etc* have been presented with sufficient details. Unlike our solar system, where the shape and size of the circum-solar disk are inferred through various observations, it is easier to infer about their existence in other stellar systems as one can directly take photographs of them.

Several such examples have been presented in this Chapter from Hubble telescope measurements and particular emphasis is given on beta-Pictoris, whose circum-stellar disk is the most well-studied object next only to the circum-solar disk.

All in all, the book, a full 804 page compendium, contains truly an astounding amount of information about dusts in various astrophysical systems. Perhaps some more discussions about extra-solar systems could have been made, as only one Chapter is dedicated in this subject. Perhaps the instrumentation part could have been placed at the end of the book rather than right in the middle. But these issues do not hamper the continuity of the subject matter. What is positive about this book is that even a beginner can enjoy reading and can learn a great deal from it. There are plenty of references and figures. At the end of the book, a glossary of the technical terms used in the book is given which is undoubtedly very useful for non-experts This is clearly 'a must have' book for all the astronomy libraries

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Landmark Papers 1926-2001
Special Issue of the Indian Journal of Physics, December 2002

edited by J K Bhattacharjee and D S Ray
IACS Jadavpur, Kolkata, India (2002)
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The Indian Association for the Cultivation of Science has been an important institution in the scientific life of India for many years and it is a pleasure to be able to congratulate it on its 125th anniversary. A special issue of the Indian Journal of Physics to celebrate also the 75th anniversary of its inception is an excellent way of marking both events.

The Guest Editors, Professors Bhattacharjee and Ray, are to be complimented on their vision and efforts to review the early issues and republish key papers that have appeared in the journal. One reads the work of such giants of science as Raman, Bose, Chandrasekar and Saha with a mixture of enjoyment and humility. I personally found it extremely interesting to appreciate for the first time the process of scientific enquiry that led up to the discovery of the Raman effect and also to see the incisiveness of analysis that Raman brought to bear on the data. When I visited the Indian Association for the Cultivation of Science, I was shown Raman's spectrometer; to read the contemporary account of the instrument's use brought the experience to life.

I believe that it is essential for a development of a healthy society that we should learn the history of how our cultural, religious and political institutions have developed. We often overlook that it is equally important to appreciate the historical development of scientific ideas, with the result that we present to our students, contemporary models and concepts as if they were handed down from a higher authority. To revisit landmark papers is an excellent way of bringing into focus not just the historical perspective but also the non-linear process of exploration and deduction that forms the scientific method. For this reason alone, I would commend this volume to all with an interest, professional or otherwise, in physics.

In the Preface, the editors argue that the volume shows that it is not the infrastructure or funding that ultimately determines the quality of scientific output, rather the ability of the individual. It is in part, but I cannot agree totally. They fail to recognise what constituted a "well funded laboratory" in the first quarter of the 20th Century. The colossal achievement of the early directors of the Indian Association for the Cultivation of Science in building such a facility should not be underestimated. Of the papers reproduced, over 60% are in theoretical physics and all except one, where the work appears to have been undertaken in Europe, of the post-independence papers are in this category. The volume shows me that India has produced some outstanding intellects and my own experience tells me that it still does. However, of contemporary scientists born in India whose work is of world class, a large number now work abroad. That exodus must inform future public investment in scientific infrastructure as the Indian economy develops in the 21st Century.

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